# Azure Storage

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# What will we accomplish?

## Purpose of this workshop

- Describe Azure Storage
- Develop the foundational Azure Storage design

# High-level agenda

- Azure Storage overview
- Storage offerings
- Storage availability and redundancy
- Storage performance
- Storage management
- Storage deployment models
- Key decisions
- Next steps

# Storage overview

# Azure Storage Services

## IaaS

Storage

Virtual machines

Networking

## PaaS

Existing frameworks

Web and mobile

Microservices

Serverless Compute

## Disks

Persistent disks for Azure IaaS VMs

Standard Storage Disks: Magnetic disk based, low IOPS, moderate latency

Premium Storage Disks: SSD based, high IOPS, low latency

Managed Disks

## Files

Fully Managed File Shares in the Cloud

SMB and REST access

"Lift and shift" legacy apps

## Blobs

Highly scalable, REST based cloud object store

Block Blobs: Sequential I/O, Hot, Cool and Archive Tiers

Page Blobs: Random-write pattern data

Append Blobs

## Tables

Massive auto-scaling NoSQL store

Dynamic scaling based on load

Scale to PBs of table data

Fast key/value lookups

## Queues

Reliable queues at scale for cloud services

Decouple and scale components
Message visibility timeout and update message to protect against unreliable dequeuers

## Built on a unified Distributed Storage System

Durability, Encryption at Rest, Strongly Consistent Replication, Fault Tolerance, Auto Load-Balancing

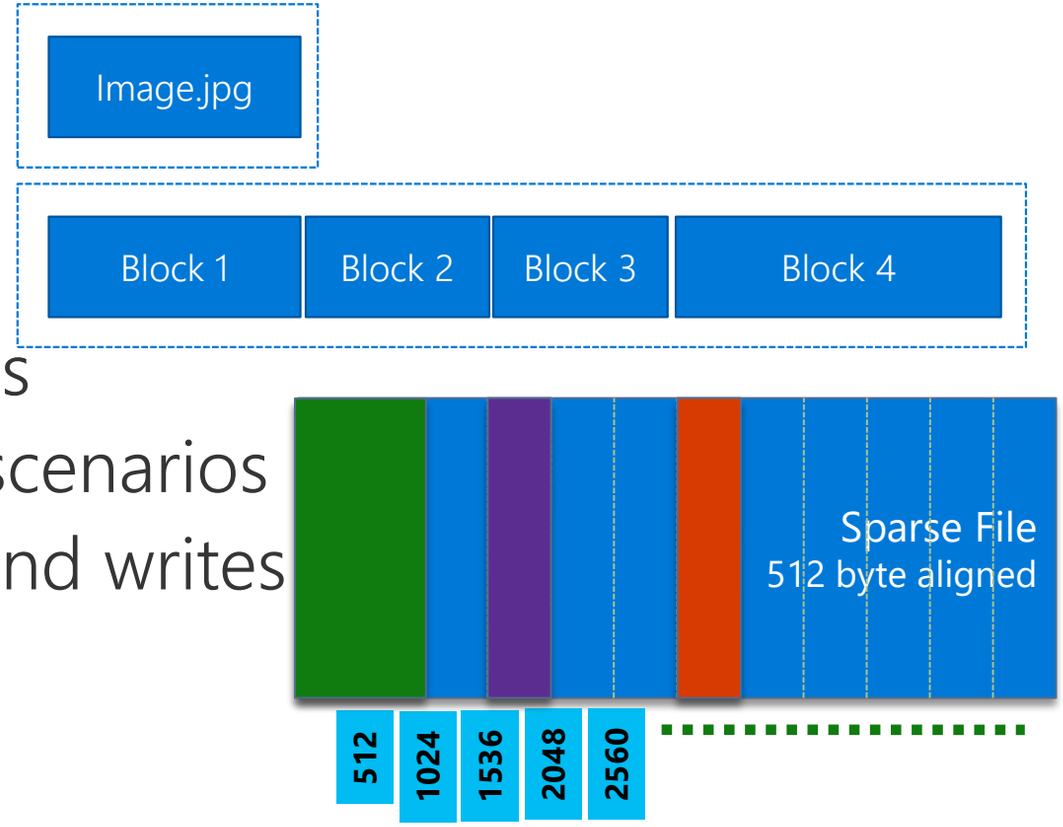
# What is the Blob Storage Service?

## Azure's Object Storage platform

- Store and serve unstructured data
  - App and Web scale data
  - Backups and Archive
  - Big Data from IoT, Genomics, etc.

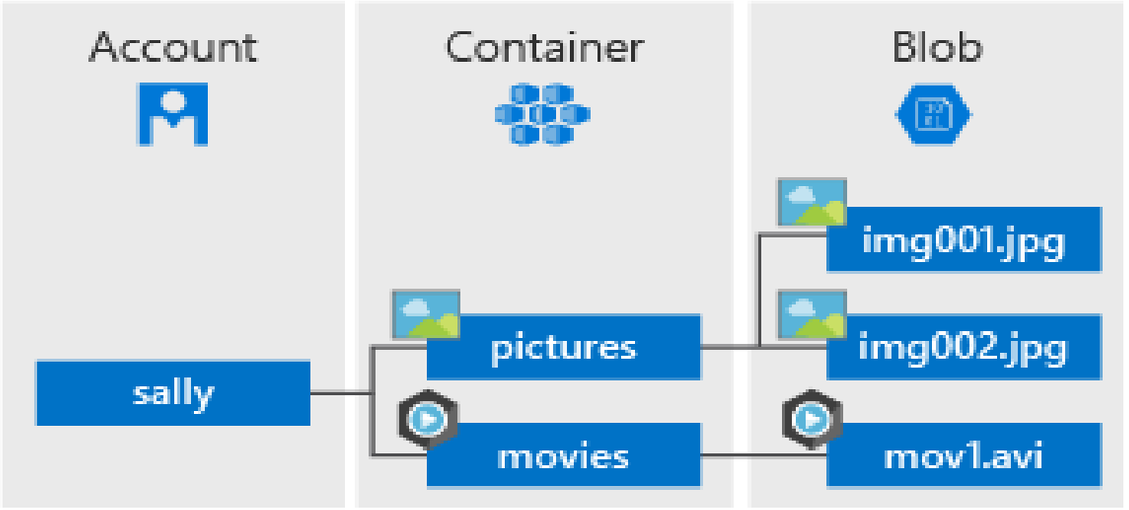
## Types of Blobs

- Block Blobs - Most object storage scenarios
- Append Blobs - Multi-writer append only scenarios
- Page Blobs - Page aligned random reads and writes



# Azure Blob storage overview

Blob storage offers three types of resources:




## Blobs

Object storage access via REST

## Blobs

"Highly scalable, REST based cloud object store"

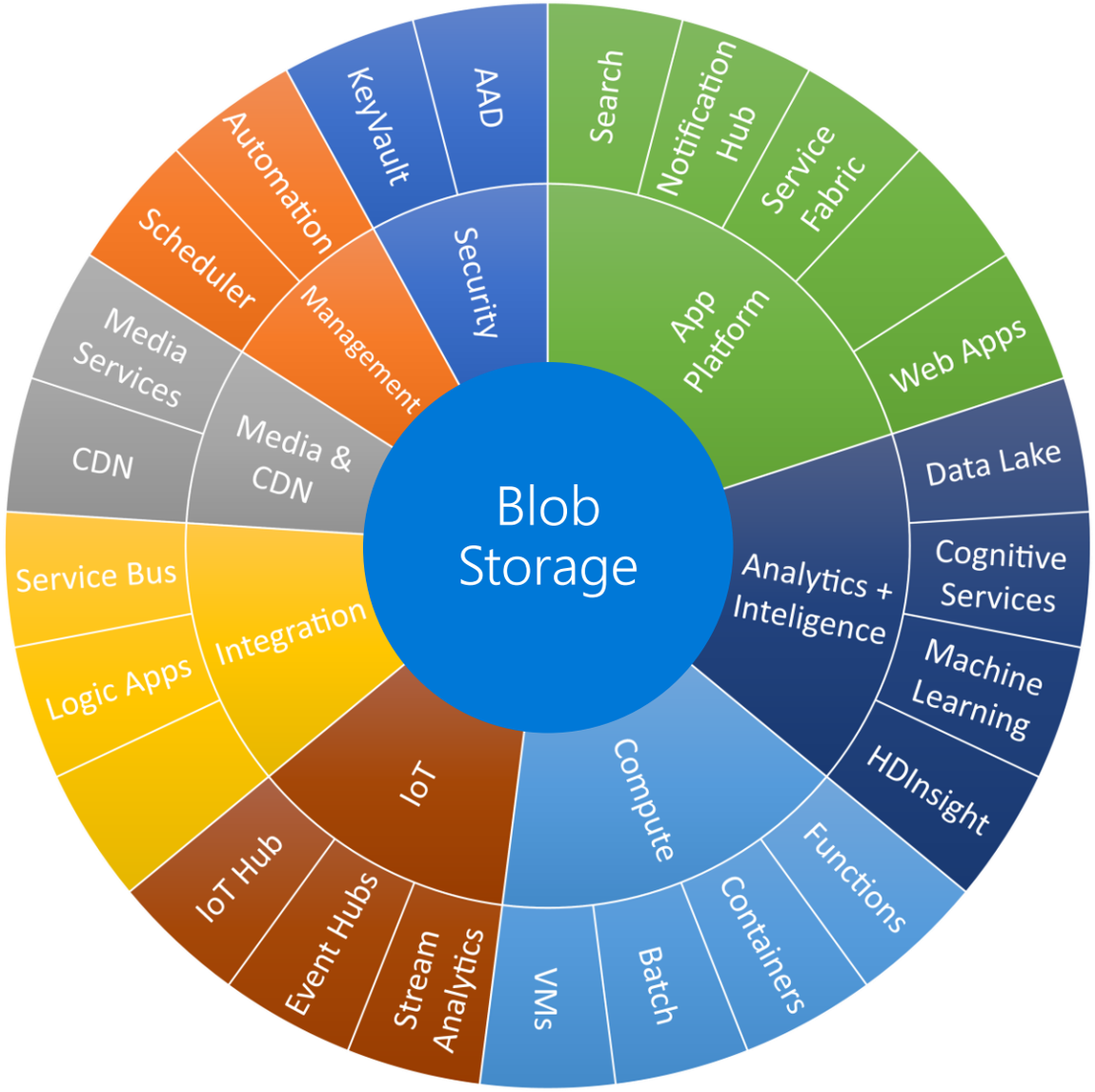
## Blobs

Designed for:

- Serving images or documents directly to a browser.
- Storing files for distributed access.
- Streaming video and audio.
- Writing to log files.
- Storing data for backup and restore, disaster recovery, and archiving.
- Storing data for analysis by an on-premises or Azure-hosted service.

Streaming & random object access scenarios

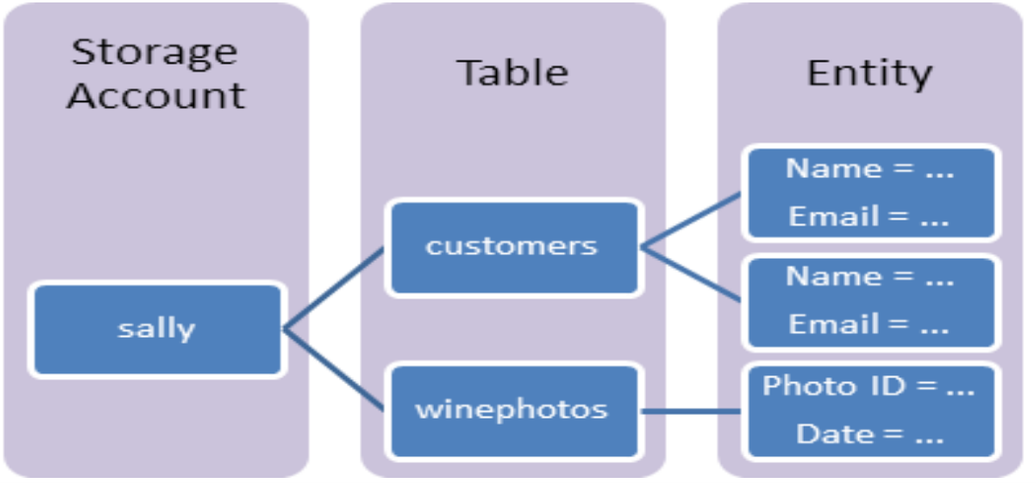
# Azure Ecosystem and Blob Storage




Broad integration for Blobs across Azure services

# Azure Table Storage overview

Table storage contains the following components:




## Tables

NOSQL storage access via REST

KeyValue Store

## Tables

"Massive auto-scaling NoSQL store"

## Tables

Azure Table storage is a service that stores structured NoSQL data in the cloud, providing a key/attribute store with a schemaless design.

You can use Table storage to store flexible datasets like user data for web applications, address books, device information, or other types of metadata your service requires. You can store any number of entities in a table, and a storage account may contain any number of tables, up to the capacity limit of the storage account.

# Azure Queues overview

## Queues

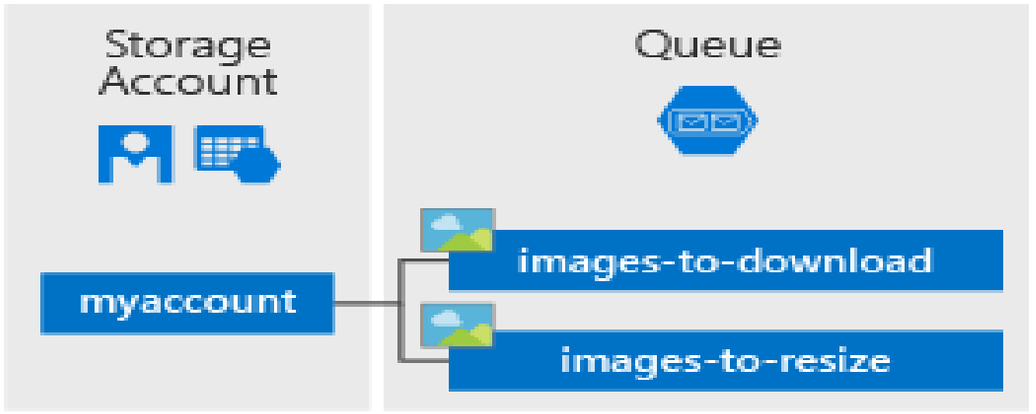
Reliable messaging access via REST

Scheduling async tasks

## Queues

"Reliable messaging at scale for cloud services"

Queue service contains the following components:




## Queues

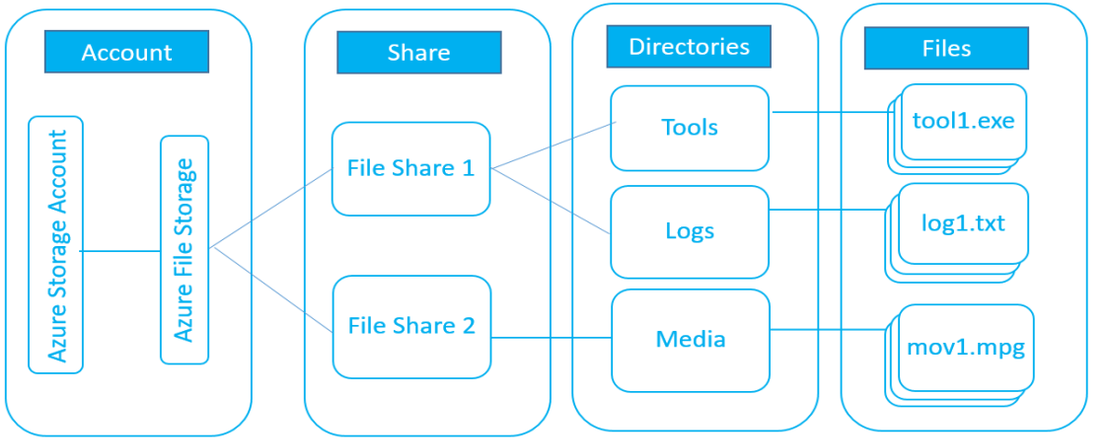
Azure Queue storage is a service for storing large numbers of messages that can be accessed from anywhere in the world via authenticated calls using HTTP or HTTPS.

Common uses of Queue storage include:

- Creating a backlog of work to process asynchronously
- Passing messages from an Azure web role to an Azure worker role

# Azure Files overview

Azure Files management constructs:




## Files

File storage
access via SMB, REST

Lift-n-shift scenarios

## Files

"SMB access to Azure Storage"

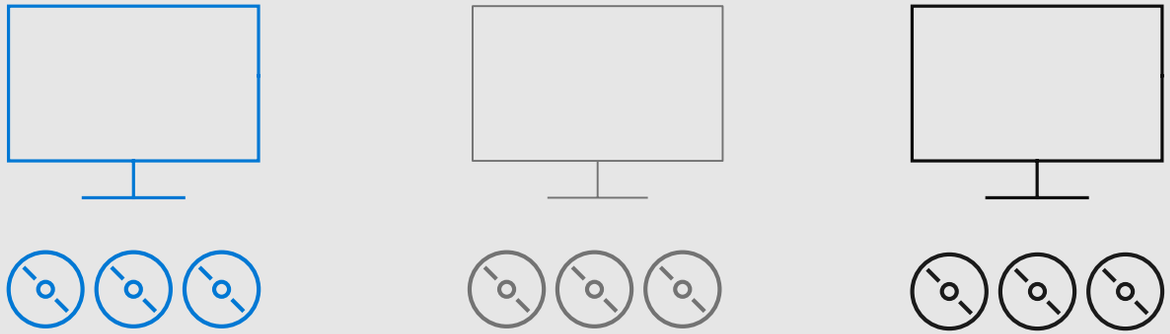
## Files

Azure Files offers fully managed file shares in the cloud that are accessible via the industry standard Server Message Block (SMB) protocol.

- Replace or supplement on-premises file servers
- Makes it easy to "**lift and shift**" applications to the cloud that expect a file share to store file application or user data
- Natively supported by OS APIs, libraries, and tools
- Built on SMB2.1, works with Windows and Linux
- No limits on number of shares; 5TB and 1000 IOPS per share

# Azure Disks

## Performance tiers



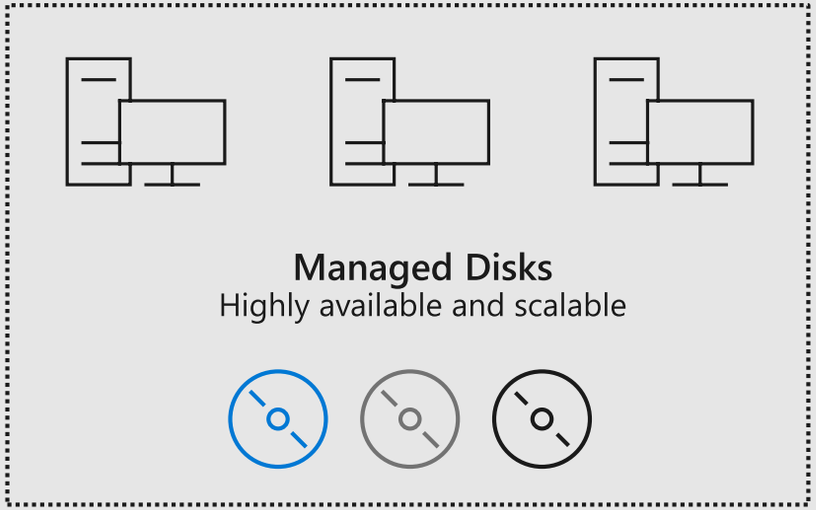
**Premium SSD Disks**
Provisioned performance
for Enterprise Prod

**Standard SSD Disks**
Cost effective performance
for entry-level workloads

**Standard HDD Disks**
HDD based, cost effective
for dev-test workloads

## Simplified management

Resource Group




### Industry leading ZERO% annual failure rate

Enterprise grade durability
with 3 replicas

### Best in class VMs with high IOPS/BW

80,000 IOPS & 2,000 MB/s
Disk throughput per VM

### < 1ms latency for cached operations

Blob Cache technology
Up to 160,000 IOPS

### Developer support

REST API support
Easy migration/DR backup
Rich partner ecosystem

# Object storage for every use case

## Azure Blob

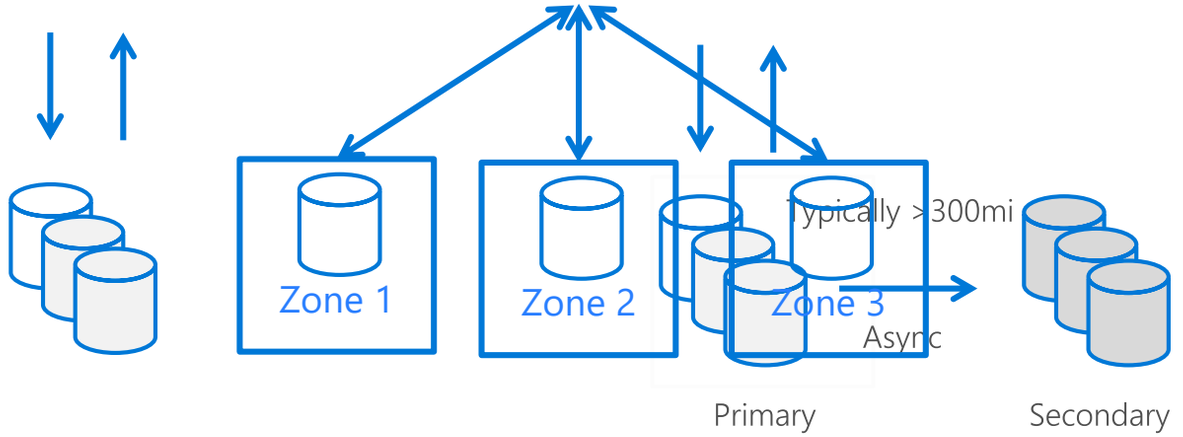
| | Hot | Cool | Archive |
|---|---|---|---|
| | Frequently accessed data | Less frequently accessed data | Rarely accessed data |
| Per TB per month | $20.80 | $15.20 | $0.99 |
| Per 10k write operations | $0.05 | $0.10 | $0.10 |
| Retrieval times | Immediate | Immediate | Hours |
| Use cases | Cloud native application data storage | Repository for server backups | Medical records archiving |

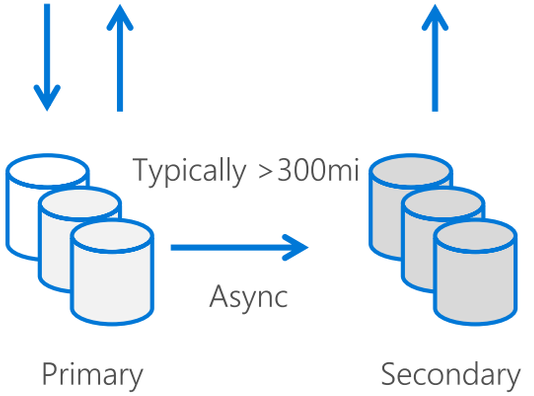
# Scalability & performance roadmap

| | Standard HDD Managed Disks | Standard SSD Managed Disks | Premium SSD Managed Disks |
|---|---|---|---|
| **Disk latency** | Double digit millisecond | Single digit millisecond | Uncached Read: ~4ms<br>Uncached Write: ~2ms -> ~1ms (Q3 CY2018) |
| **Max disk size** | 4TB -> 32TB (H2 CY18) | 4TB -> 32TB (H2 CY18) | 4TB -> 32TB (H2 CY18) |
| **Max disk IOPS** | 500 IOPS | 500 IOPS | 7,500 IOPS |
| **Max disk bandwidth** | 60 MBps | 60 MBps | 250 MBps |

* The disk performance target is subject to change

# Storage redundancy models




## Locally-redundant storage (LRS)

3 replicas, 1 region

Protect against disk, node, rack failures

Write is ack'd when all replicas are committed

Superior to dual-parity RAID

## Zone-redundant storage (ZRS) v2

3 replicas **across 3 Zones**

Protect against disk, node, rack and **zone** failures

**Synchronous writes** to all 3 zones

## Geo-redundant storage (GRS)

6 replicas, 2 regions (3/region)

Protects against major regional disasters

Asynchronous to secondary

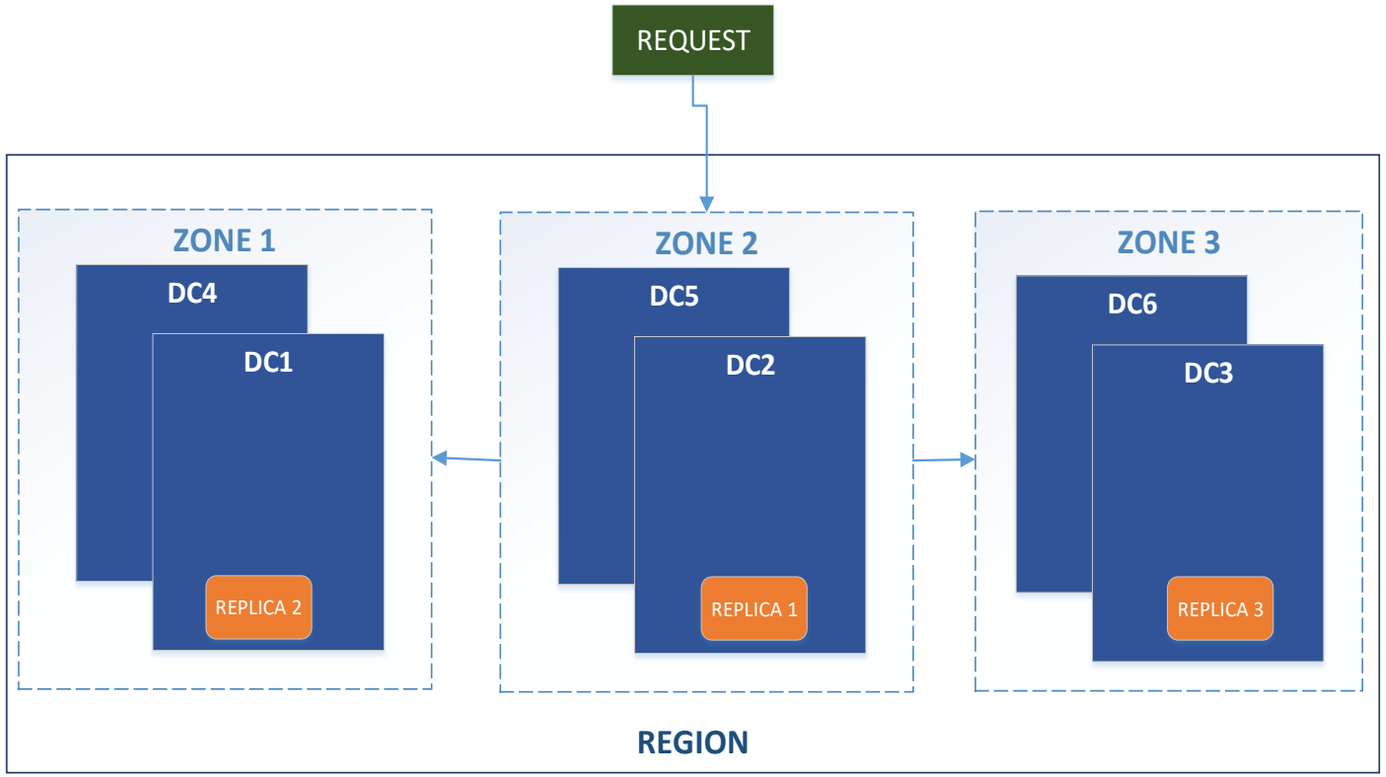
## Read-access Geo-redundant storage (RA-GRS)

GRS + Read access to secondary

Separate secondary endpoint

RPO delay to secondary can be queried

# Azure Zone Redundant Storage (ZRS)




Read / write resilience against single cluster / DC unavailability

Support for Blob, Table, File, Queue Storage

| LRS | ZRS | GRS | RA-GRS |
|---|---|---|---|
| Resilient to disk/node/rack failures | Resilient to single cluster / datacenter outage | Resilient to regional outage | Resilient to regional outage<br>Read access to second region |

# Paired regions

| Geography | Paired regions | |
|---|---|---|
| **Asia** | East Asia | Southeast Asia |
| **Australia** | Australia East | Australia Southeast |
| **Australia** | Australia Central | Australia Central 2 |
| **Brazil** | Brazil South | South Central US |
| **Canada** | Canada Central | Canada East |
| **China** | China North | China East |
| **China** | China North 2 | China East 2 |
| **Europe** | North Europe | West Europe |
| **France** | France Central | France South |
| **Germany** | Germany Central | Germany Northeast |
| **India** | Central India | South India |
| **India** | West India | South India |
| **Japan** | Japan East | Japan West |
| **Korea** | Korea Central | Korea South |
| **North America** | East US | West US |
| **North America** | East US 2 | Central US |
| **North America** | North Central US | South Central US |
| **North America** | West US 2 | West Central US |
| **UK** | UK West | UK South |
| **US Department of Defense** | US DoD East | US DoD Central |
| **US Government** | US Gov Arizona | US Gov Texas |
| **US Government** | US Gov Iowa | US Gov Virginia |
| **US Government** | US Gov Virginia | US Gov Texas |

https://docs.microsoft.com/en-us/azure/best-practices-availability-paired-regions

# Types of storage accounts

| Storage account type | Supported services | Supported performance tiers | Supported access tiers | Replication options | Deployment model | Encryption |
|---|---|---|---|---|---|---|
| General-purpose V2 | Blob, File, Queue, Table, and Disk | Standard, Premium | Hot, Cool, Archive | LRS, GRS, RA-GRS, ZRS, ZGRS (preview), RA-ZGRS (preview)[4] | Resource Manager | Encrypted |
| General-purpose V1 | Blob, File, Queue, Table, and Disk | Standard, Premium | N/A | LRS, GRS, RA-GRS | Resource Manager, Classic | Encrypted |
| Block blob storage | Blob (block blobs and append blobs only) | Premium | N/A | LRS | Resource Manager | Encrypted |
| FileStorage | Files only | Premium | N/A | LRS | Resource Manager | Encrypted |
| Blob storage | Blob (block blobs and append blobs only) | Standard | Hot, Cool, Archive | LRS, GRS, RA-GRS | Resource Manager | Encrypted |

# Storage access control strategies

## Multiple access control strategies

- Storage account key – Full access
- Shared access signature (SAS) – Token with configurable rights and time
- Public – Blob storage only

## Shared access signature

- Resources – Account (coming soon), containers, Blobs, queues, tables, table ranges
- Permissions – Read, write, delete, etc.
- Time – Start time, end time

**https://storageaccount.blob.core.windows.net/sascontainer?sv=2012-02-12&se=2013-04-13 T00%3A12%3A08Z& sr=c&sp=wl& sig=t%2BbzU9%2B7ry4okULN9S0wst%2F8MCUhTjrHyV9rDNLSe8g%3Dsss**

# Azure Files and Azure file Sync

# What is Azure Files?

## Cloud file shares that are…

### Easily managed

No servers required

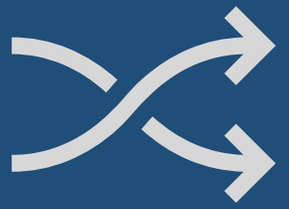
### Secure

Data encrypted at rest and in transit

### Cross-platform

Mount on Windows, Linux, and macOS

*Protocols: SMB 2.1, 3.0, and REST*



### Built for a hybrid world

Access data where you want to, how you want to

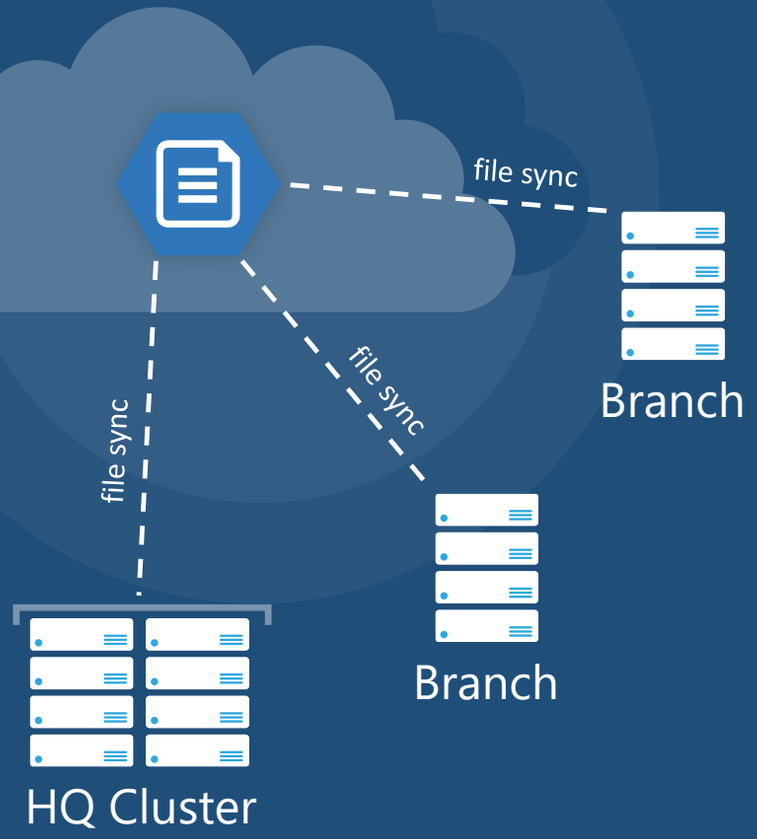
### Smart

Make the most of limited networks with intelligent caching

### Harmonious

Migrate applications to the cloud without the headaches

# Azure File Sync




Centralize file services in Azure storage

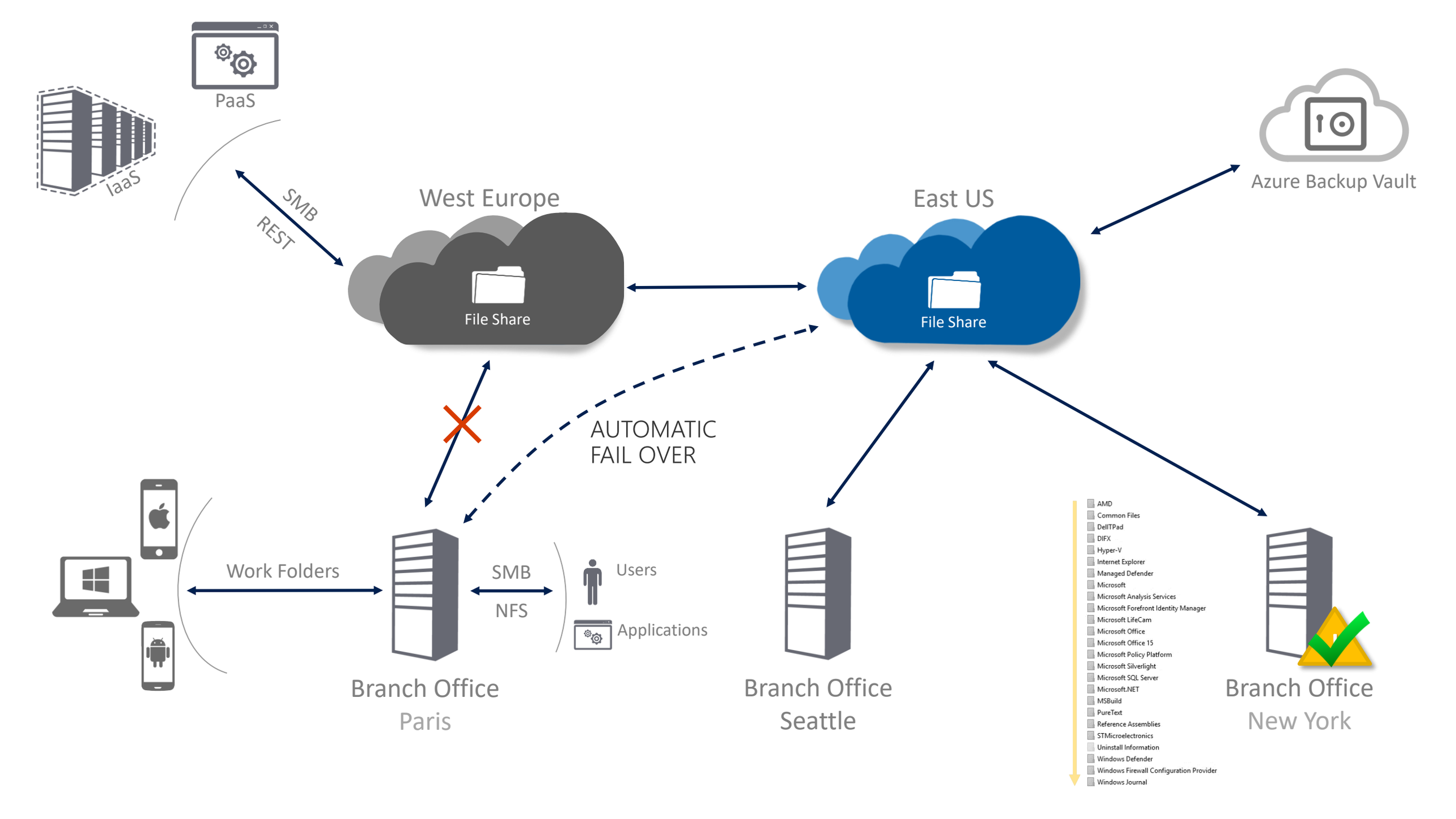
Cache in multiple locations for fast, local performance

Utilize cloud-based backup and fast DR

Maintain on-prem compatibility

# Azure File Sync - Scenarios

| | |
|---|---|
| Multi-site sync | Keep a data set in sync across multiple locations |
| Cloud tiering | Cloud tiering is an optional feature of Azure File Sync in which frequently accessed files are cached locally on the server while all other files are tiered to Azure Files based on policy settings. It turns a server into a lightweight, disposable, performance cache for Azure Files |
| Direct cloud access | Native file format with SMB and REST access |
| Integrated cloud backup | Point-in-time recovery and retention policies without redundant data transfer |
| Rapid file server DR | Fast namespace sync with no need to wait for data restore |


PaaS
IaaS
SMB
REST
West Europe
File Share
East US
File Share
Azure Backup Vault
AUTOMATIC
FAIL OVER
Work Folders
SMB
NFS
Users
Applications
Branch Office
Paris
Branch Office
Seattle
Branch Office
New York
AMD
Common Files
DellTPad
DIFX
Hyper-V
Internet Explorer
Managed Defender
Microsoft
Microsoft Analysis Services
Microsoft Forefront Identity Manager
Microsoft LifeCam
Microsoft Office
Microsoft Office 15
Microsoft Policy Platform
Microsoft Silverlight
Microsoft SQL Server
Microsoft.NET
MSBuild
PureText
Reference Assemblies
STMicroelectronics
Uninstall Information
Windows Defender
Windows Firewall Configuration Provider
Windows Journal

# Managed Disks

# Azure Managed Disks Benefits

Best value persistent storage for your business critical workloads

## Secure by Default

Encryption at Rest
Granular RBAC

## Highly Available

Prevents single points of failure due to storage

## Simple

No operational costs for disk management

## Big Scale

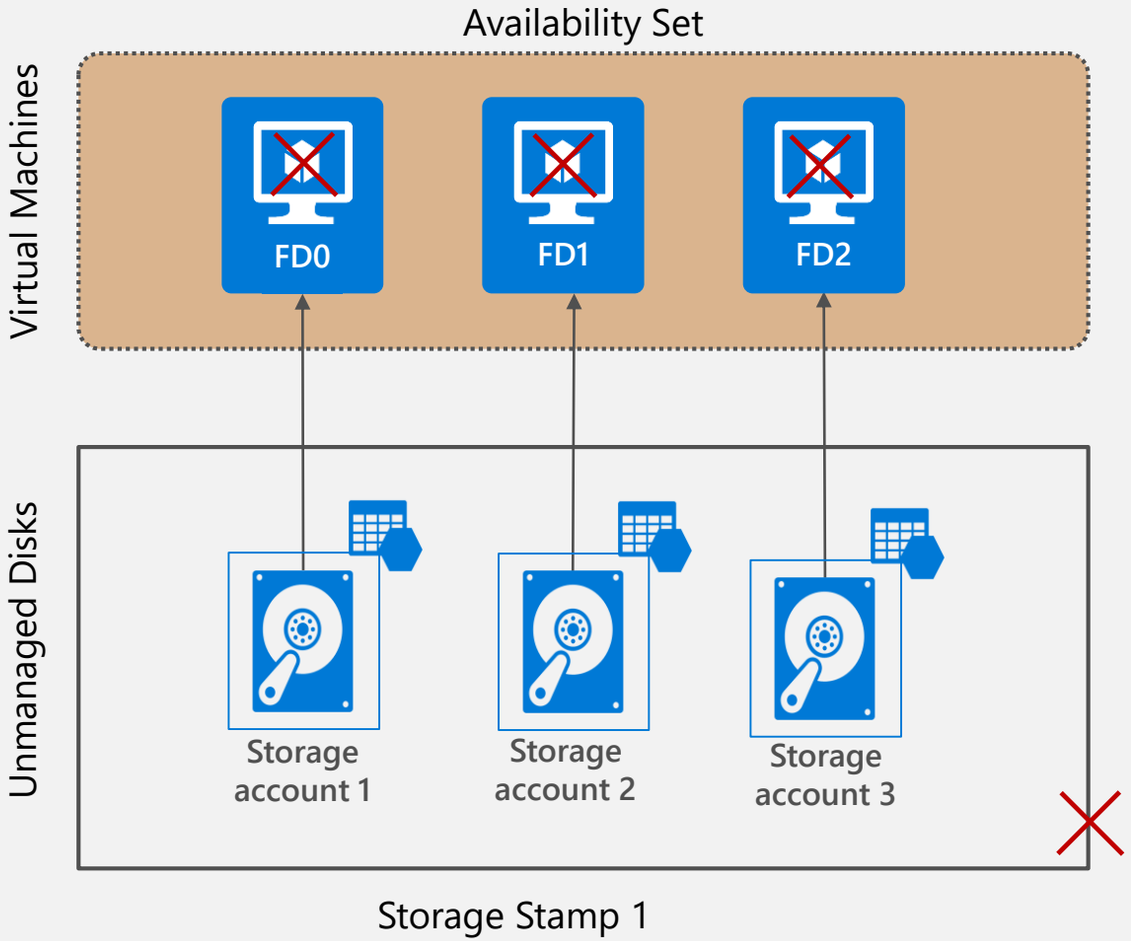
50,000 disks per region per subscription
No throttling due to storage account IOPS limits

# Managed Disks Security

## Managed Disks are Secure by Default

- Managed disks provide granular Role-based Access Control for your disks
- Storage Service Encryption by default
- Azure Disk Encryption using your own keys

# VM Availability with Unmanaged Disks

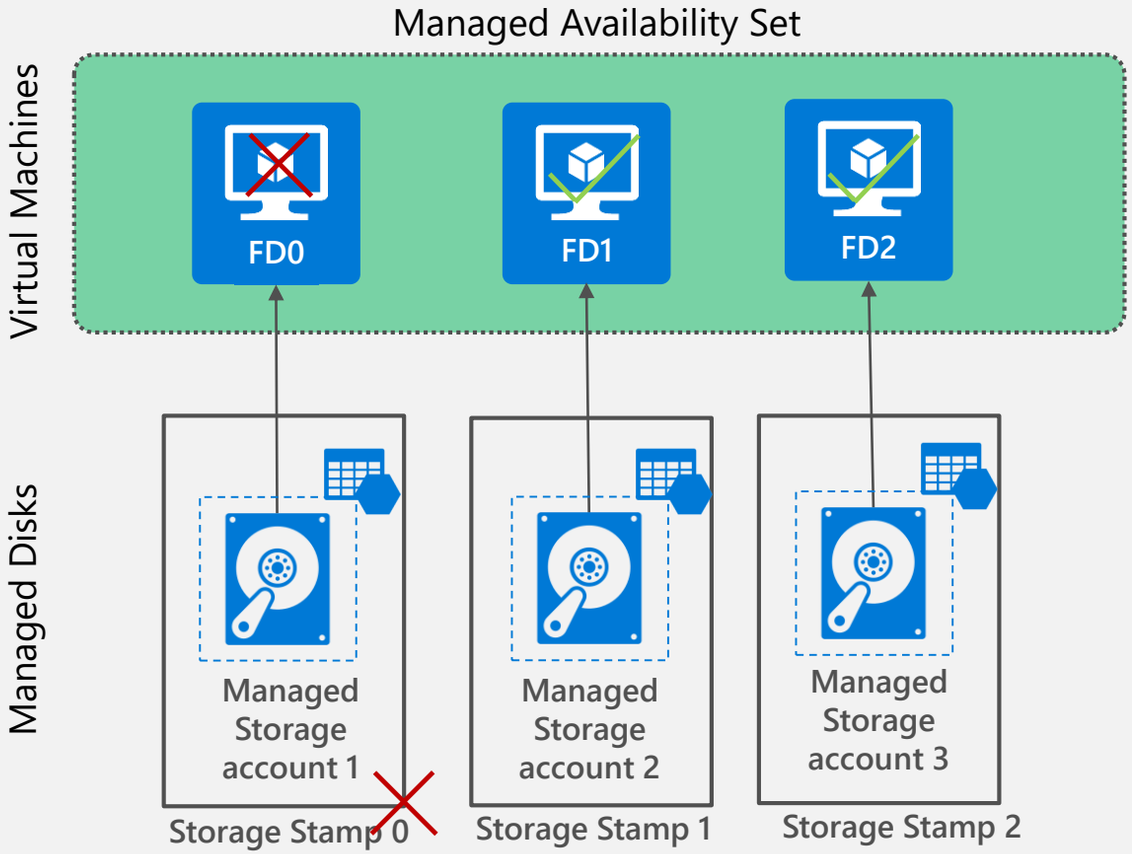



☹

Azure Availability Sets protect Virtual Machines from compute related outages

Unmanaged disks do not protect against single storage scale unit outages

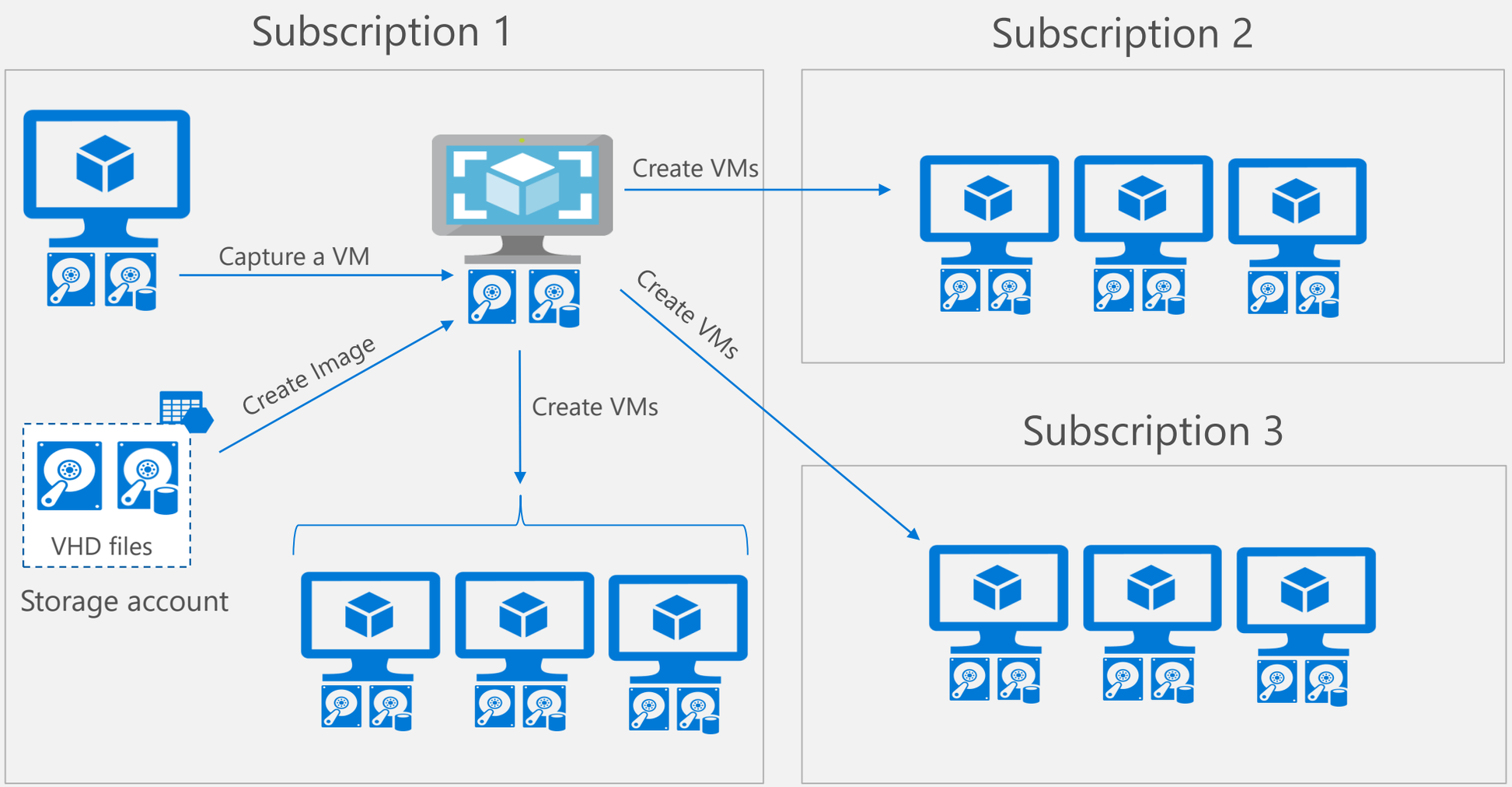
# VM Availability with Managed Disks




Managed Availability Sets protect Virtual Machines from compute related outages

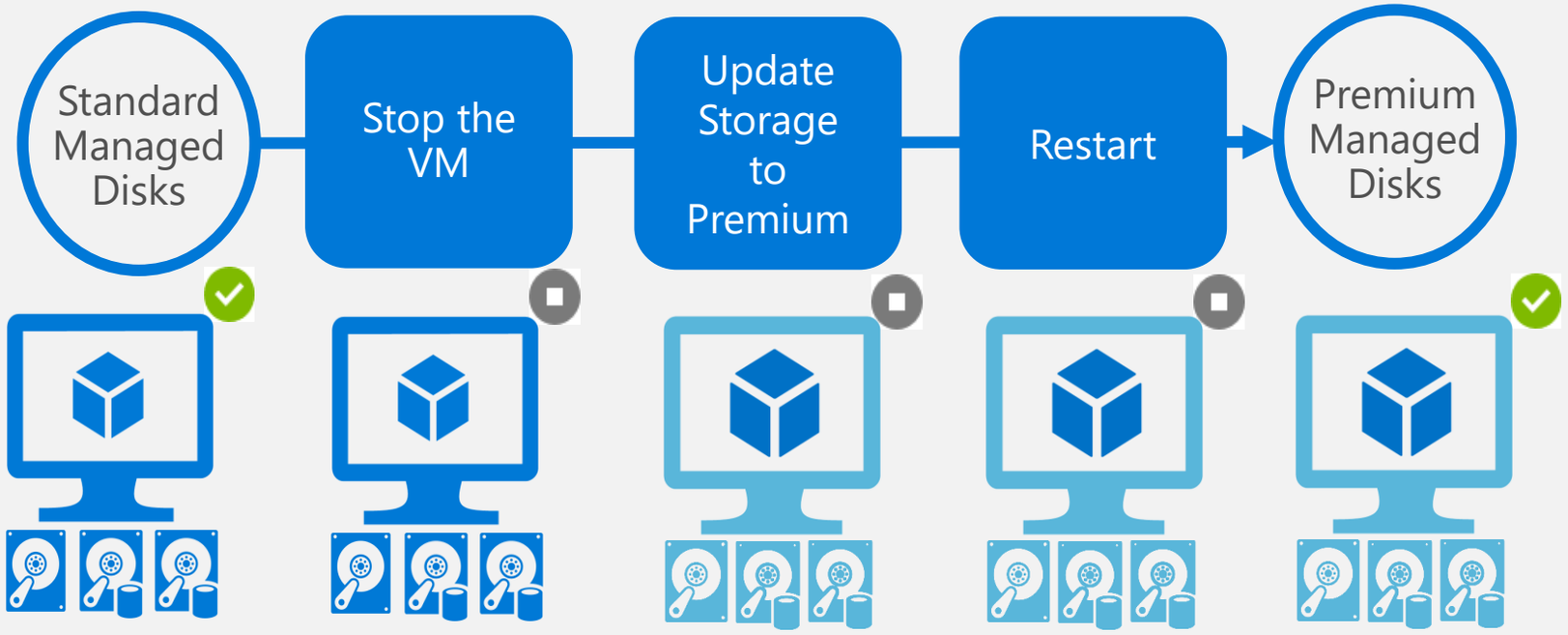
Managed disks protect against single storage scale unit outages

# Reusable Custom Images across subscriptions



# Unmanaged – Complex upgrade from Standard to Premium

# Managed – Easy upgrade from Standard to Premium

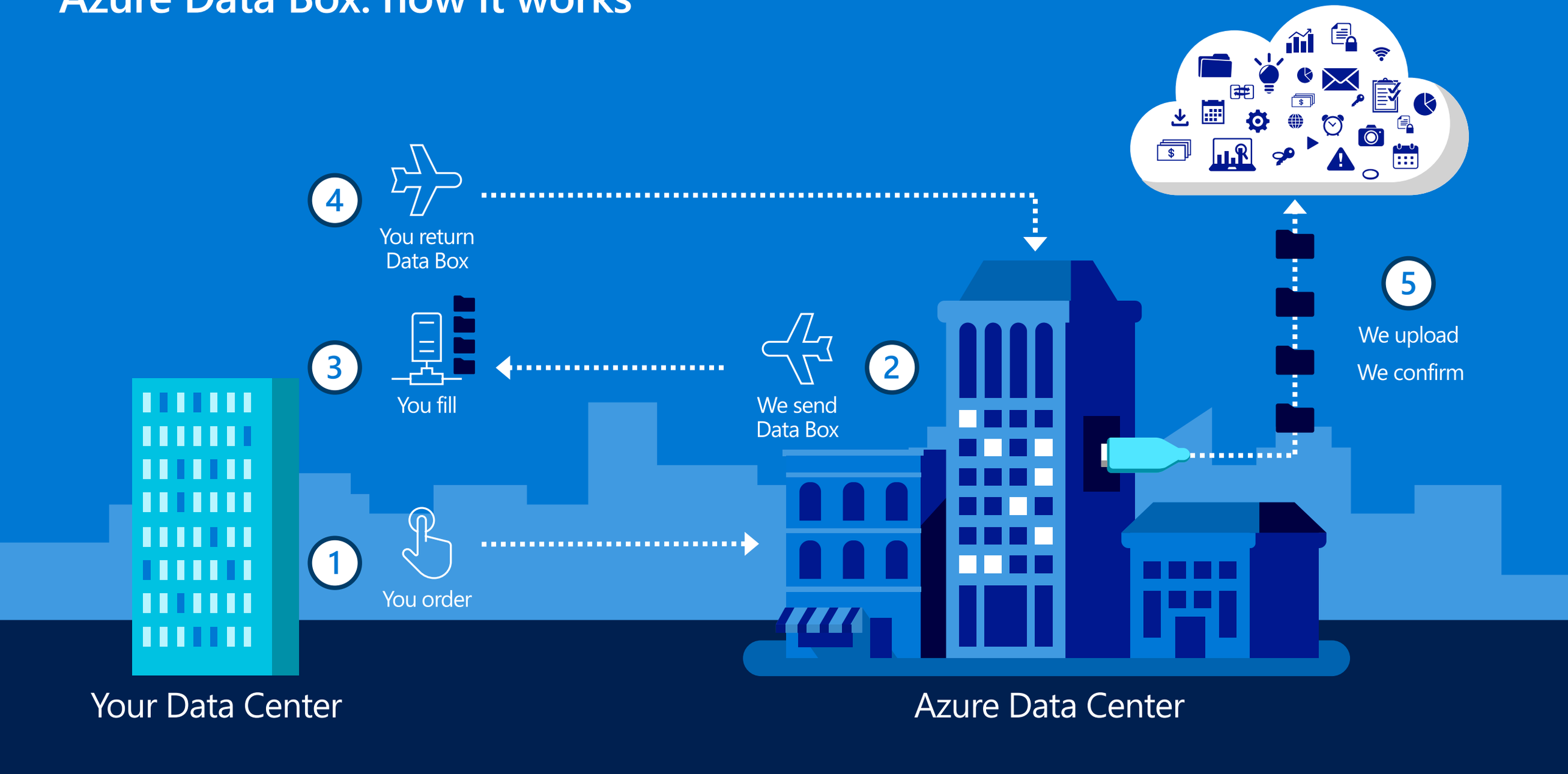



☺< 5 minutes downtime
☺Downtime only for reboot
☺No manual data copy
☺Single click upgrade

# Data at the edge

## Moving data from the edge into Azure with the Data Box family

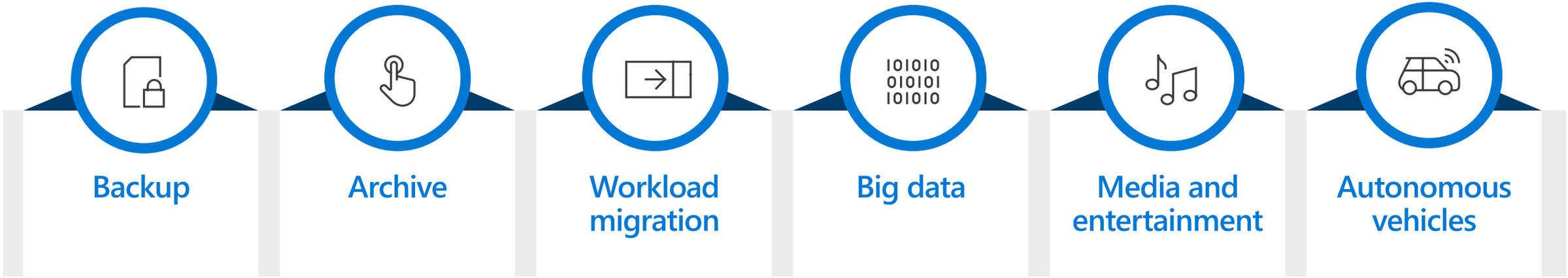
# Azure Data Box: how it works



# Data at the edge

## Data Box online appliances empower cloud data management

### SCENARIOS



# Data Box offline device selection

| Data qty | 45 Mbps (T3) | 100 Mbps | 1 Gbps | 10 Gbps |
|---|---|---|---|---|
| 1 TB | 2 days | 1 day | 2 hours | 14 minutes |
| 10 TB | 22 days | 10 days | 1 day | 2 hours |
| 35 TB | 76 days | 34 days | 3 days | 8 hours |
| 80 TB | 173 days | 78 days | 8 days | 19 hours |
| 100 TB | 216 days | 97 days | 10 days | 1 day |
| 200 TB | 1 years | 194 days | 19 days | 2 days |
| 500 TB | 3 years | 1 years | 49 days | 5 days |
| 1 PB | 6 years | 3 years | 97 days | 10 days |
| 2 PB | 12 years | 5 years | 194 days | 19 days |

**Key**

- Use the network
- Use Data Box Disk
- Use Data Box
- Use Data Box Heavy

Use a Data Box when data volume exceeds network capacity

Note: the table is based on 100% available network bandwidth

# Azure Data Box: offline transfer options

Available for small, medium, or large migrations

| PRODUCTS | CAPACITY | DESCRIPTION |
| --- | --- | --- |
|  Data Box Disk | 8 TB, up to 40 TB | USB 3.1 SSD disks<br>Order up to 5 in each pack |
|  Data Box | 100 TB | Ruggedized, self-contained appliances |
|  Data Box Heavy | 1 PB | |

# Data Box—technical summary


| Specification | Details |
|---|---|
| Storage capacity | 100TB raw/~80TB usable |
| Data protection/security | AES 256-bit BitLocker encryption |
| Weight | ~50 lbs/20 kg |
| Network interface | 1x1/10 GbE RJ45 for management<br>1x1/10 GbE RJ45 and 2x10GbE SFP+ for data transfer |
| Access protocol | SMB/CIFS and NFS<br>Azure Blob storage via REST API |
| Supported Azure storage types | Block Blob, Page Blob, Azure files and Managed Disk |
| Physical security | Tamper-evident ruggedized device casing |
| Power | 110/240 (50/60 Hz) |
| Dimensions | 17″ H x 20″ D x 12.2″ W<br>43 cm x 51 cm x 31cm |

# Data Box Disk—technical summary


| Specification | Details |
|---|---|
| Storage capacity | 8TB raw/7 TB useable; up to five disks per order for 40TB raw/35TB useable total capacity |
| Data protection/security | AES 128-bit encryption & NIST 800-88r1 sanitization |
| Device connection | USB 3.1, SATA II or III |
| Media | 2.5″ Solid State Drive (SSD) |
| Supported OS | Windows (7,8,10), Windows Server (2008, 2012, 2016)<br>Linux: CentOS 6.9+, RHEL 6.9+, Ubuntu 14+, Debian 8+ |
| Supported Azure storage types* | Block Blob, Page Blob, Azure Files and Managed Disk |
| Power | No external power required |
| Dimensions (h/w/d) | Each - 0.4″ x 2.8″ x 4″ |

* Currently valid for GPv1, GPv2 and Blob storage accounts

# Data Box Heavy—technical summary


| Specification | Details |
|---|---|
| Storage capacity | 1 PB raw/~800TB usable |
| Data protection/security | AES 256-bit BitLocker encryption |
| Weight | <500 lbs/227 kg |
| Network interface | 2x1/10GbE RJ45 for management<br>4x40GbE QSFP+ for data transfer |
| Access protocol | SMB/CIFS and NFS<br>Azure Blob Storage via the REST API |
| Supported Azure storage types | Block Blob, Page Blob, Azure Files and Managed Disk |
| Physical security | Tamper-evident ruggedized device casing |
| Power | 110/240 (50/60 Hz) |
| Dimensions | 27″H x 44″D x 26″W<br>69cm x 112cm x 66cm |

# Data Box pricing for offline solutions

| | Data Box | Data Box Disk | Data Box Heavy |
|---|---|---|---|
| Location | US | US | US |
| Import service fee/ order processing fee | $250 | $50 | $4,000 |
| Daily Disk usage fee[1] | | $10 | |
| Extra day fee | $15/day | | $100 |
| Device shipping | $95 | $30 | ~$1,500[2] |

1. Daily Disk usage fee includes first three days as a grace period
2. Starting shipping price. May be higher depending on carrier, and shipping options

Data Box pricing currently in effect

# Data Box partners: more benefits

The Azure Data Box partner page

- **Validated solution partners can publish Data Box solutions, including a short value prop statement**
- **Publish links to your product details, solution briefs**

**https://aka.ms/databoxpartners**

Microsoft

## Azure Data Box Partners

Accelerate your migrations to Azure with Data Box partner solutions designed to fit your needs

Click here to order Data Box

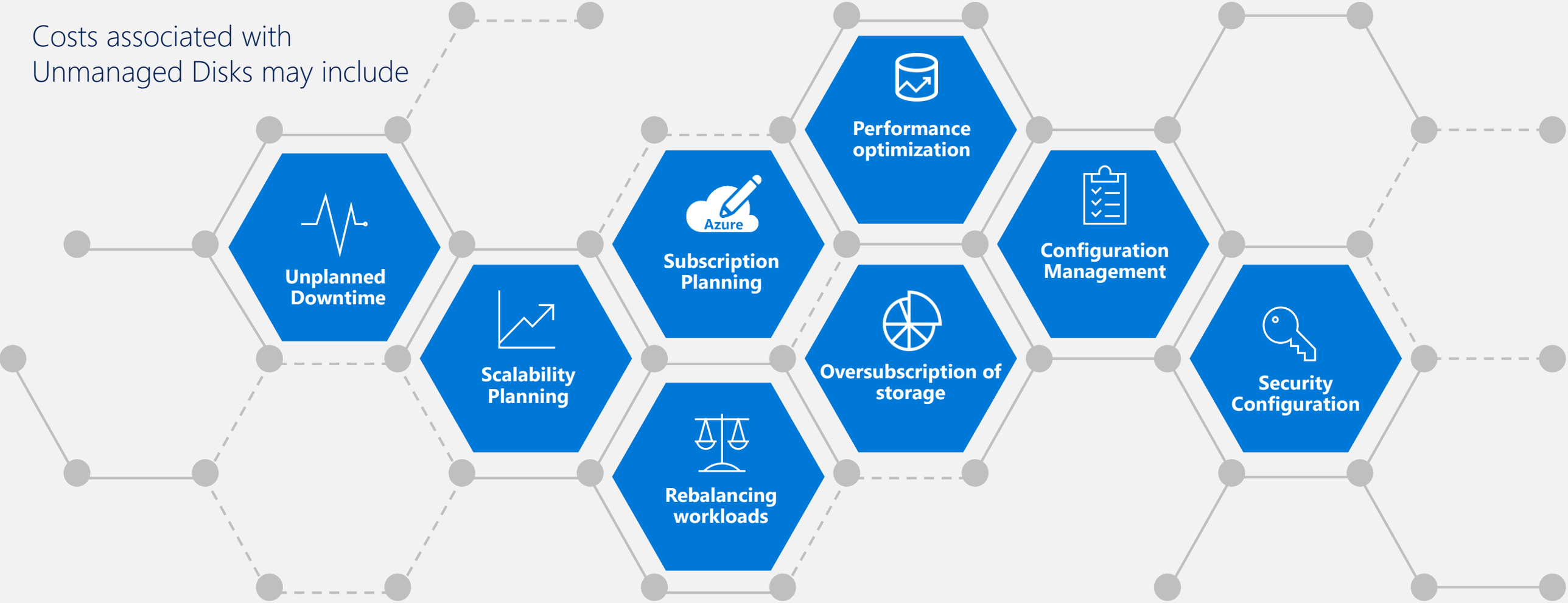
07/29/2019

| Company Link | Solution Brief | Archive and Backup | Disaster Recovery | Data Mgmt. Services | Big Data | Media and Entertainment |
|---|---|---|---|---|---|---|
| ARCHIVE360 | Archive 360 | ● | | | | |
| Automated Intelligence | Automated Intelligence | | | ● | | |
| AVID | Avid | ● | ● | ● | | ● |
| CARBONITE | Carbonite | ● | ● | | | |
| COHESITY | Cohesity | ● | | | | |
| COMMVAULT | Commvault | ● | ● | ● | ● | |
| Datadobi | Datadobi | ● | | | | |
| DATA DYNAMICS | Data Dynamics | ● | ● | | | |
| DefendX Software | DefendX | ● | | | | |
| DICOMATICS | Dicomatics | | | ● | | |
| HealthCatalyst | Health Catalyst | ● | | | | |
| HubStor | Hubstor | ● | | ● | | |
| Interlake | Interlake | | | | | ● |
| PEER | Peer Software | | | ● | | |
| ROBIN | Robin Systems | | | | ● | |
| rubrik | Rubrik | ● | | | | |
| teradata. | Teradata | ● | | ● | ● | |
| VEEAM | Veeam | ● | | | | |
| WANdisco | WANdisco | | | ● | ● | |
| Zerto | Zerto | | ● | | | |

# Tools and Best Practices

# Realize the benefits by eliminating operational costs associated with Unmanaged Disks

Costs associated with Unmanaged Disks may include

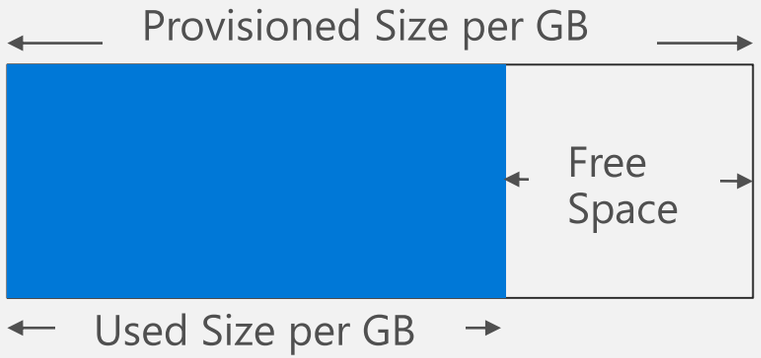


# Billing Models for Persistent Disks

## Provisioned Size Cost Model

Used by:

- Azure Premium Unmanaged Disks
- Azure Premium Managed Disks
- Azure Standard Managed Disks
- Other Cloud Platforms




## Consumed Size Cost Model

Used by:

- Azure Standard Unmanaged Disks

# Disks - Best Practices

Always use Premium Disks for Production workloads

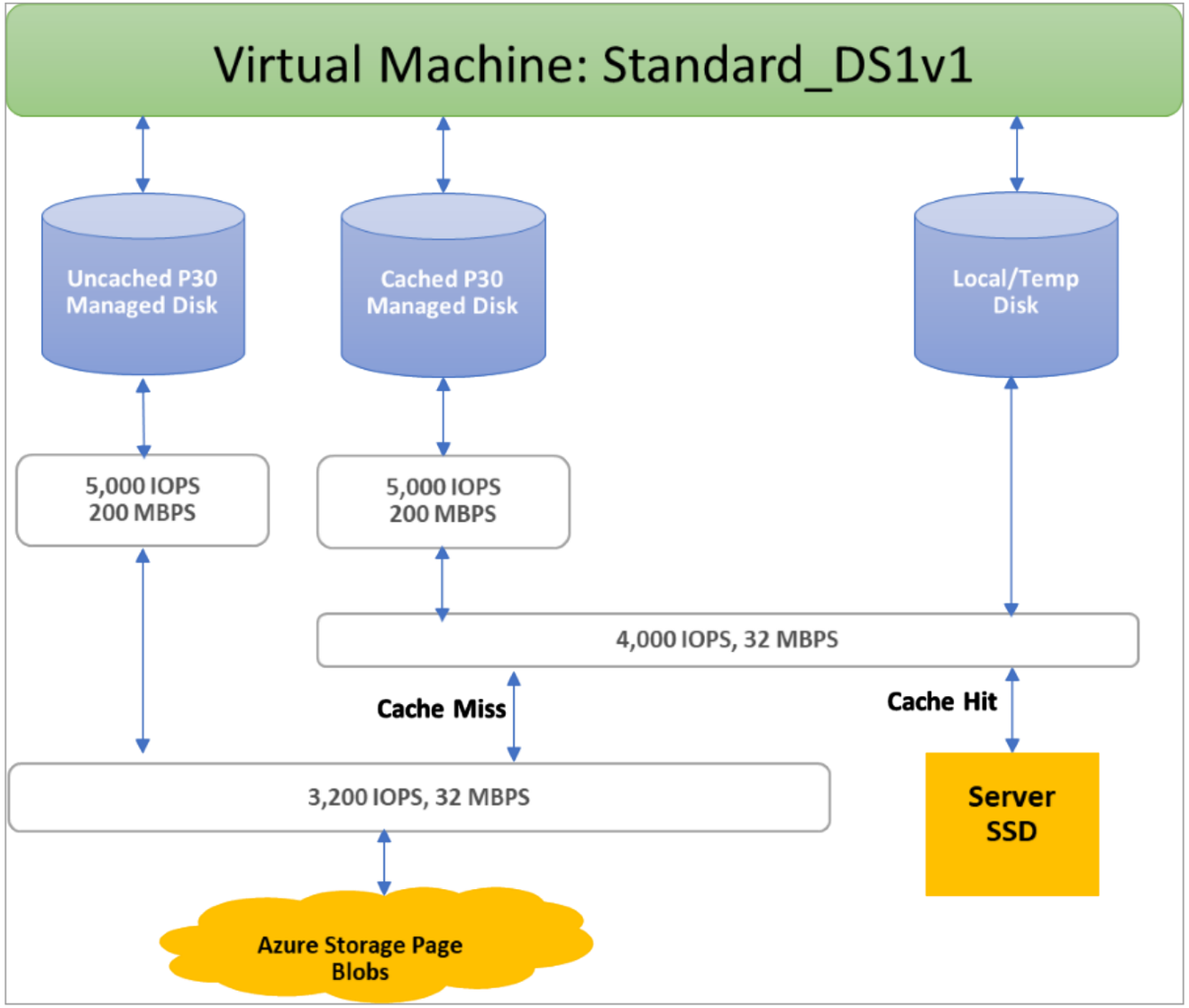
RAID for redundancy is not necessary

- RAID for performance as needed
- Durability doesn't remove the need for backups

Performance

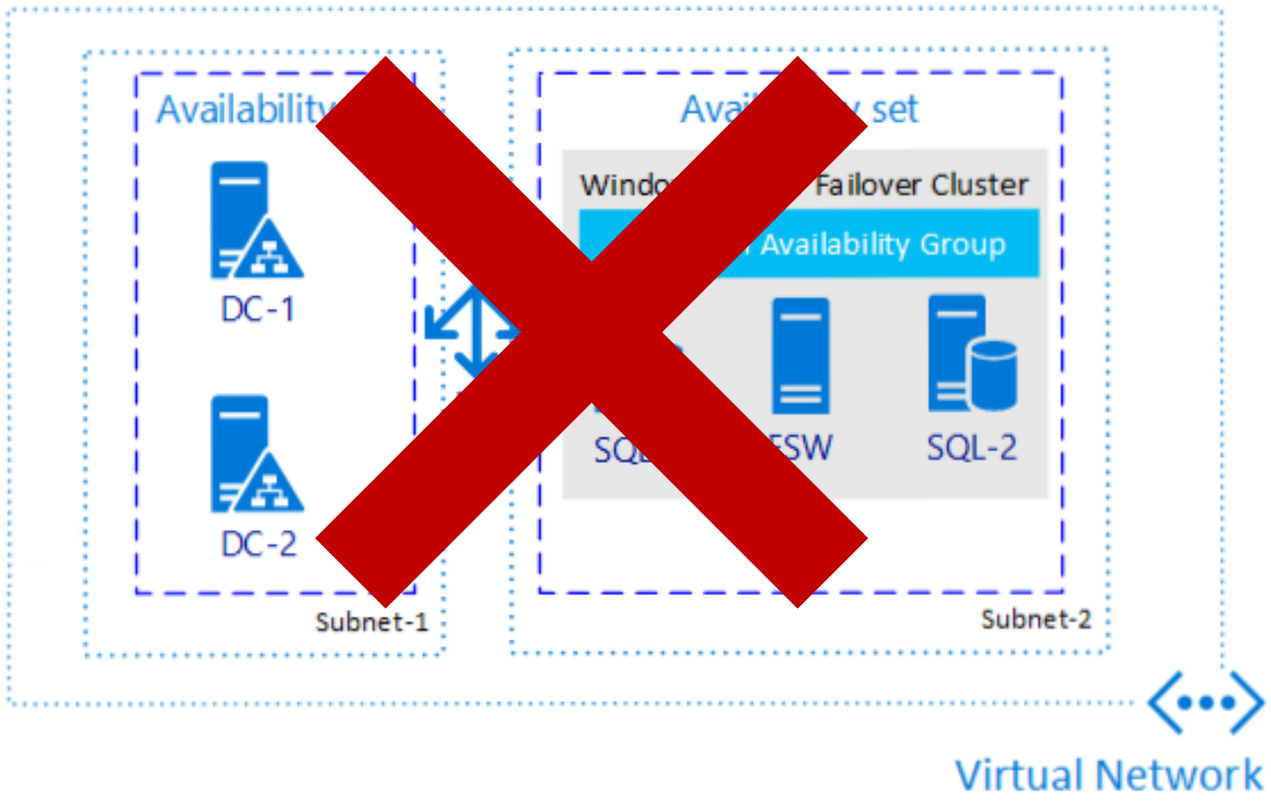
- Local ssd is **definitely** temporary, use if you can tolerate loss
- Enable read caching where appropriate for better performance
- Understand VM limits vs Disk limits for performance

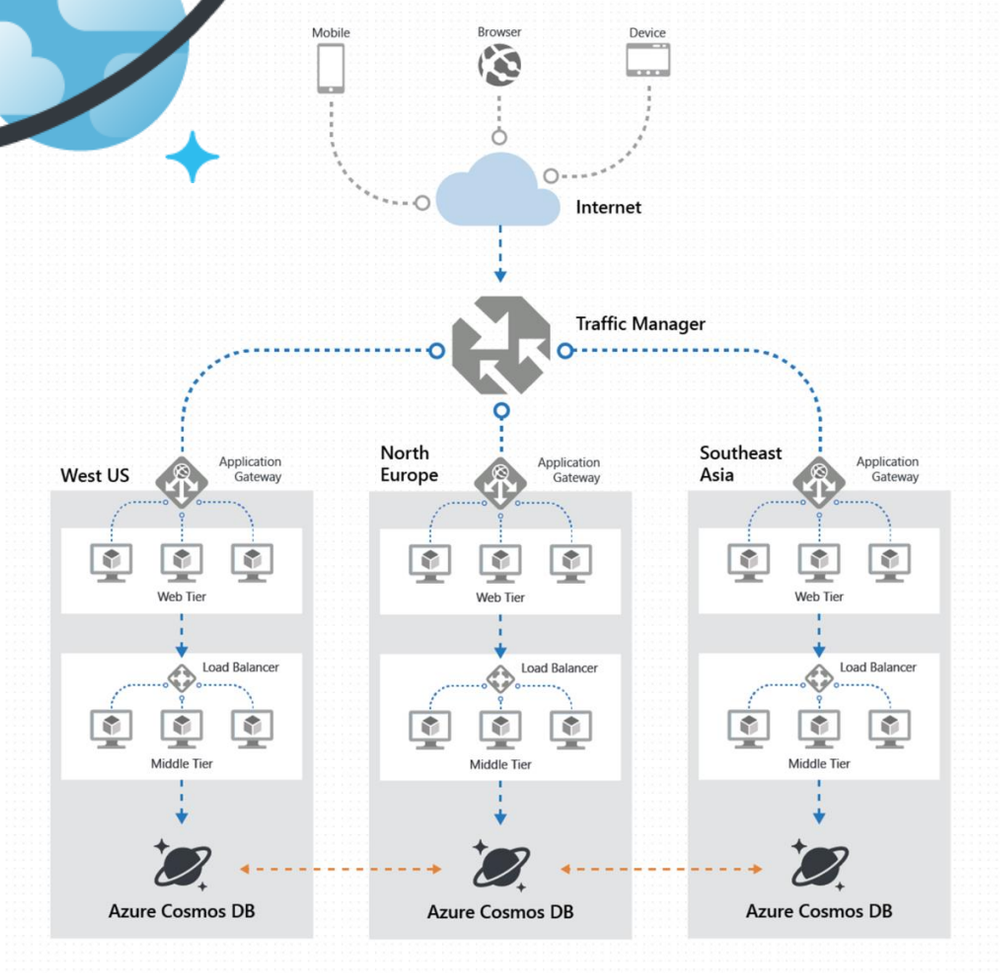
# Disk Allocation and Performance



# Global Distribution vs BCDR

RA-GRS is not Global Read/Write



# Azure Storage Explorer

## Easy Storage Management

Create, delete, view, and edit resources in Azure Storage, Azure Cosmos DB, and Data Lake Storage.

## Powerful Experience

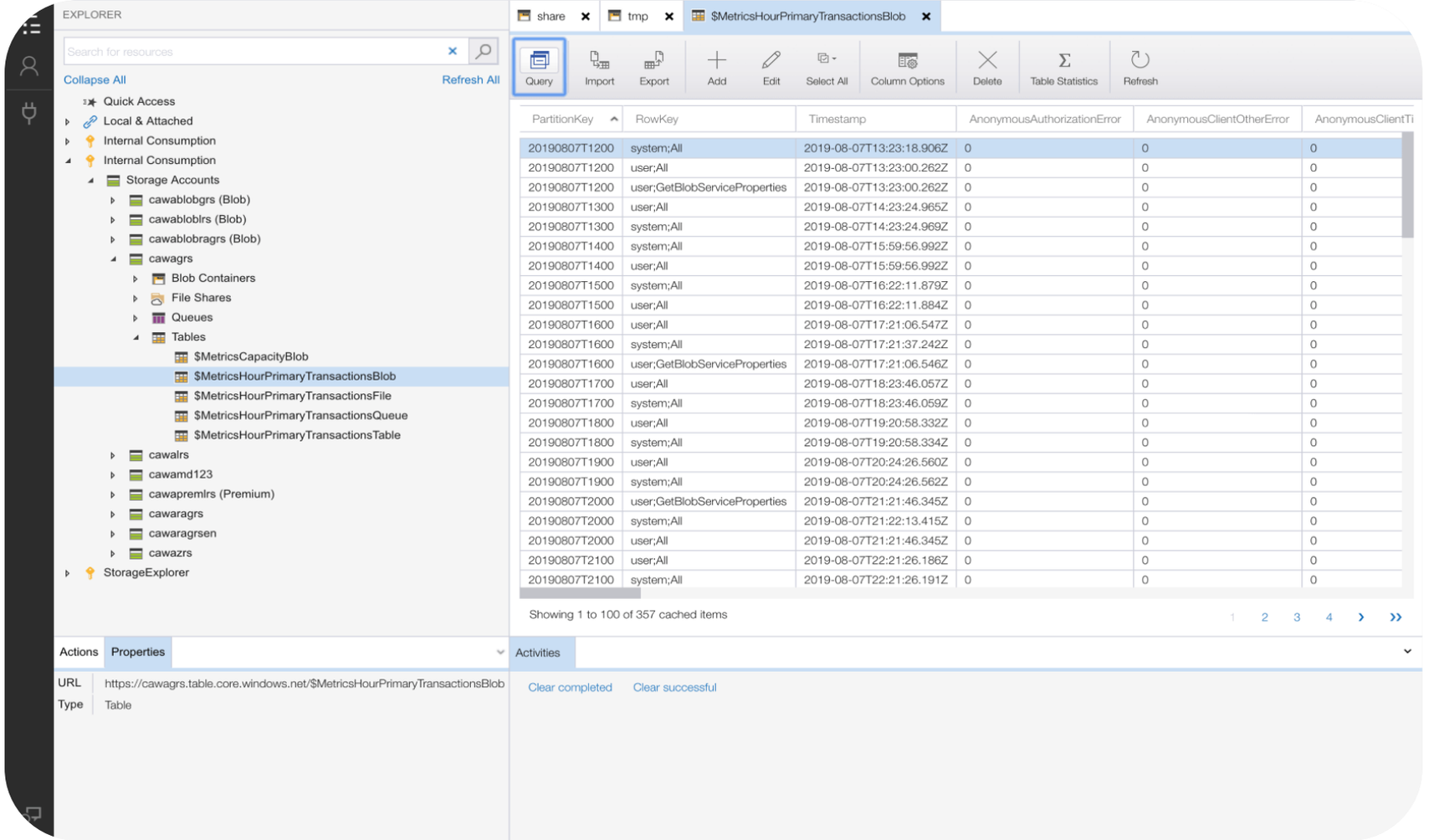
Seamlessly view, search, and interact with your data and resources

## Online or Off

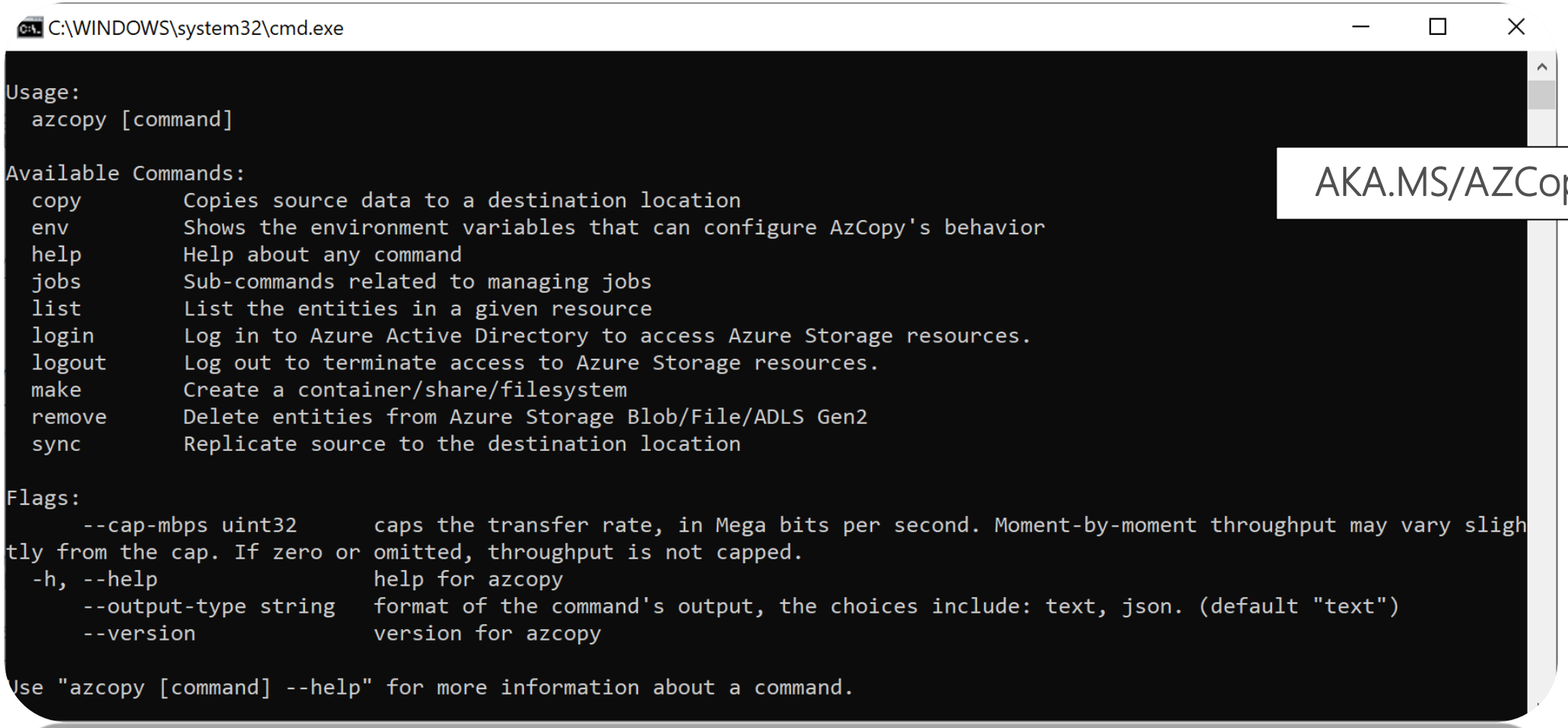
Work disconnected from the cloud or offline with local emulators

## Secure

Use the full range of Azure security features, including role-based access control, Azure Active Directory, and connection strings, to connect and manage your Azure resources—always over HTTPS



# AZCopy

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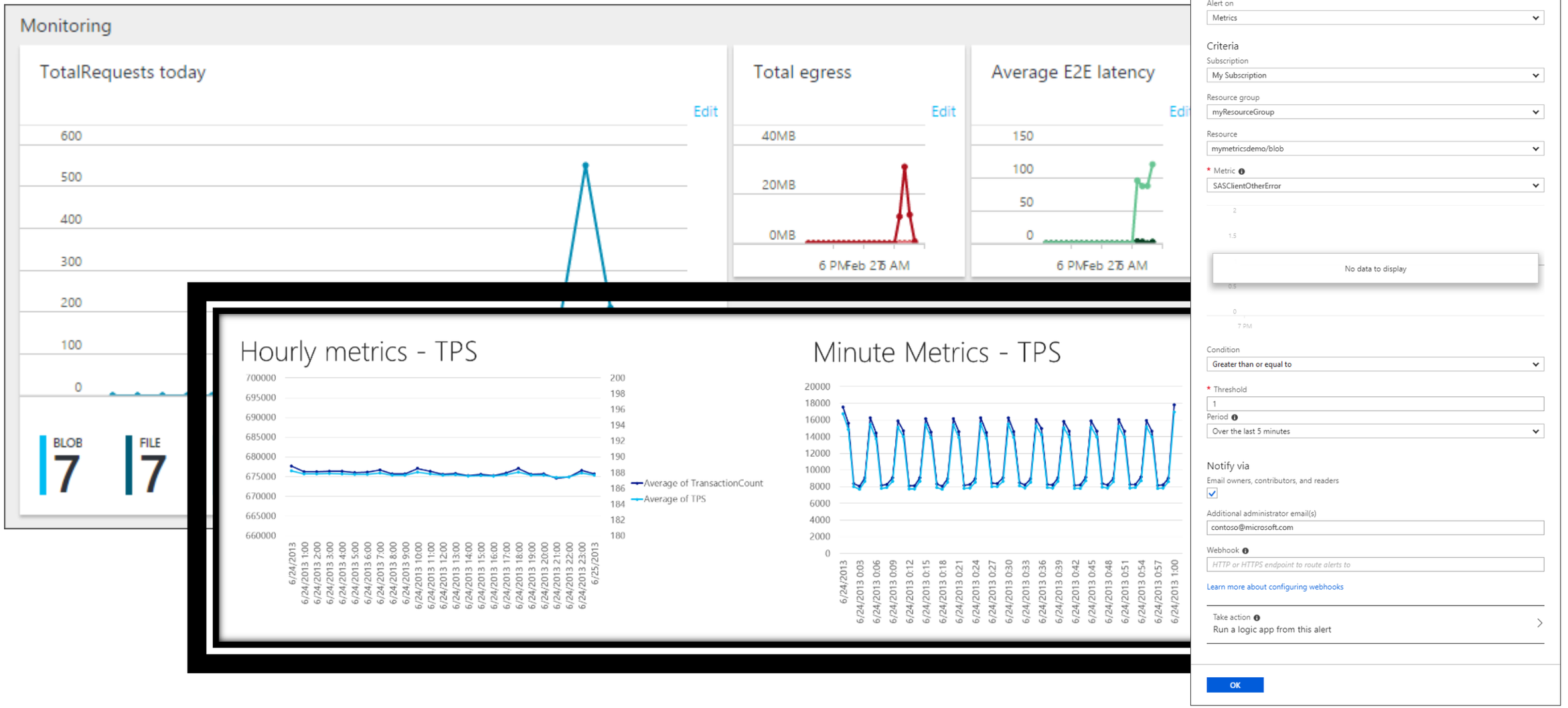
# Monitoring


Monitoring
TotalRequests today
Edit
600
500
400
300
200
100
0
BLOB
7
FILE
7
Total egress
Edit
40MB
20MB
0MB
6 PM
Feb 25
6 AM
Average E2E latency
Edit
150
100
50
0
6 PM
Feb 25
6 AM
Hourly metrics - TPS
700000
695000
690000
685000
680000
675000
670000
665000
660000
200
198
196
194
192
190
188
186
184
182
180
Average of TransactionCount
Average of TPS
6/24/2013
6/24/2013 1:00
6/24/2013 2:00
6/24/2013 3:00
6/24/2013 4:00
6/24/2013 5:00
6/24/2013 6:00
6/24/2013 7:00
6/24/2013 8:00
6/24/2013 9:00
6/24/2013 10:00
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6/24/2013 18:00
6/24/2013 19:00
6/24/2013 20:00
6/24/2013 21:00
6/24/2013 22:00
6/24/2013 23:00
6/25/2013
Minute Metrics - TPS
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
6/24/2013
6/24/2013 0:03
6/24/2013 0:06
6/24/2013 0:09
6/24/2013 0:12
6/24/2013 0:15
6/24/2013 0:18
6/24/2013 0:21
6/24/2013 0:24
6/24/2013 0:27
6/24/2013 0:30
6/24/2013 0:33
6/24/2013 0:36
6/24/2013 0:39
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6/24/2013 0:48
6/24/2013 0:51
6/24/2013 0:54
6/24/2013 0:57
6/24/2013 1:00
Add rule
* Name
myStorageAlertRule
Description
Alert on Client Authorization Errors
Source
Alert on
Metrics
Criteria
Subscription
My Subscription
Resource group
myResourceGroup
Resource
mymetricsdemo/blob
* Metric
SASClientOtherError
2
1.5
No data to display
0.5
0
7 PM
Condition
Greater than or equal to
* Threshold
1
Period
Over the last 5 minutes
Notify via
Email owners, contributors, and readers
Additional administrator email(s)
contoso@microsoft.com
Webhook
HTTP or HTTPS endpoint to route alerts to
Learn more about configuring webhooks
Take action
Run a logic app from this alert
OK